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Inoue et al.

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(54) **GOLF CLUB MANUFACTURING METHOD**

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1.53(d), and is subject to the twenty year
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154(a)(2).

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473/324

(58) Field of Search **29/527.5; 473/324,**
473/349, 345, 350, 342, 329; 164/80, 495

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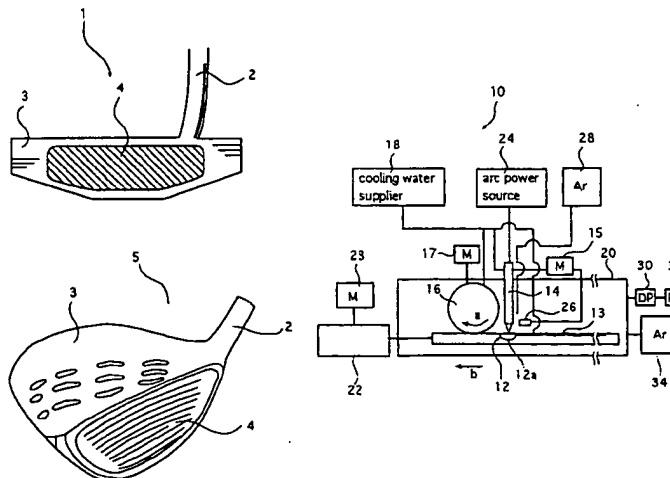
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(57) **ABSTRACT**

A golf club which has a clubface of desired shape compris-
ing an alloy metal is provided. The golf club has excellent
strength properties as well as excellent ball hitting proper-
ties. The clubface is free from casting defects such as cold
shuts, and preferably, free from the crystalline phase formed
from crystal nuclei through nonuniform nucleation since the
club face is produced in a simple, highly reproducible,
one-step process by selectively cooling the molten metal at
a temperature above the melting point at a rate higher than
the critical cooling rate, and the product comprises a single
amorphous phase. The metallic glass face used in the golf
club is produced by filling a metal material in a hearth;
melting said metal material by using a high-energy heat
source which is capable of melting said the metal material;
pressing said the molten metal at a temperature above the
melting point of said the metal material to deform the molten
metal into the desired shape by at least one of compressive
stress and shear stress at a temperature above the melting
point, while avoiding the surfaces of the molten metal
cooled to a temperature below the melting point of said the
metal material from meeting with each other during the
pressing; and cooling said the molten metal at a cooling rate
higher than the critical cooling rate of the metal material
simultaneously with or after said the deformation to produce
the metallic glass face of desired form.

15 Claims, 10 Drawing Sheets





US006089992A

United States Patent [19]

Onuki et al.

[11] **Patent Number:** **6,089,992**[45] **Date of Patent:** **Jul. 18, 2000**[54] **GOLF CLUB HEAD**

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[21] **Appl. No.:** 09/130,444[22] **Filed:** Aug. 6, 1998[30] **Foreign Application Priority Data**

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[51] **Int. Cl.⁷** A63B 53/04[52] **U.S. Cl.** 473/324; 473/342; 473/349[58] **Field of Search** 473/342, 349, 473/409, 324, 345[56] **References Cited****U.S. PATENT DOCUMENTS**

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Primary Examiner—Kien T. Nguyen*Attorney, Agent, or Firm*—Armstrong, Westerman, Hattori, McLeland & Naughton[57] **ABSTRACT**

In a golf club head having a face body, the face body is composed of a hybrid of an amorphous phase layer and a crystal phase layer. The crystal phase layer is disposed on a reverse face side of a face. And, thickness of the face body is 0.5 mm to 5.0 mm, thickness of the amorphous phase layer is, on average in whole area of the face body, more than 50% of the thickness of the face body, and thickness of the crystal phase layer is arranged to be 0.01 mm to 3.0 mm.

7 Claims, 28 Drawing Sheets